

**Commonwealth of Massachusetts
Office of Consumer Affairs & Business Regulation
Division of Energy Resources**

**RENEWABLE ENERGY PORTFOLIO STANDARD
ADVISORY RULING**

**FOR
HEMPHILL POWER AND LIGHT
REGARDING THE JANSEN TECHNOLOGY
PROPOSED FOR RETOOLING ITS BIOMASS POWER PLANT**

January 7, 2005

1. Advisory Ruling Request by Hemphill Power and Light

Hemphill Power and Light (hereafter, Hemphill), through the agency of CSG Services, has requested that the Massachusetts Division of Energy Resources (DOER) provide an Advisory Ruling¹ with regard to the qualification under the Massachusetts Renewable Energy Portfolio Standard (RPS) of a technology proposed for retooling the combustion chamber of its biomass-fueled power plant in Springfield, New Hampshire.² Hemphill requested that this Advisory Ruling be limited to the technology alone, and not encompass the proposed fuel and the expected air emissions. However, this document does make some preliminary remarks on those aspects of the proposed project, as well.

2. Existing Conditions and Description of the Proposed Retooling Project

The existing Unit is a 1987, Babcock and Wilcox, wood-fired boiler with a 16 MW steam generator. The boiler is a conventional unit with a “hydrograte” stoker. The current stoker combustion technology of the Unit does not qualify as “advanced power conversion technology” required for biomass Units under the regulations at 14.05(1)(a)6. Rather than seeking to attain New Renewable Generation qualification by means of an extensive retooling with fluidized bed combustion, as has been proposed by others in several earlier requests for Advisory Rulings, Hemphill proposes a more modest retooling for which several advantages over fluidized bed retooling are claimed. In addition to technical advantages, which are discussed below, these include the financial advantages of a much shorter period during which the Unit must be off-line for the retooling and lower capital and maintenance costs.

Hemphill proposes to engage the services of Jansen Combustion and Boiler Technologies, Inc., of Kirkland, Washington, to analyze the boiler and to engineer and substantially modify the existing configuration of combustion air injection into the combustion chamber, including the

¹ The RPS regulations, at 225 CMR 14.06(5), provide an opportunity for a Generation Unit owner or developer “to request an advisory ruling from the Division to determine whether a Unit would qualify as a New Renewable Generation Unit.” Hereafter, all references to the RPS regulations will be to sections of 225 CMR 14.00. More information about Advisory Rulings for MA RPS is at <http://www.mass.gov/doer/rps/advisory.htm>.

² The request was made in a document from Jennifer Lange of CSG Services dated August 19, 2004 (hereafter, the 8/19/04 Request). That followed up a slide set that had been presented by Hemphill, Jansen, and CSG at the offices of CSG Services in Westborough, MA, on July 28, 2004 (hereafter, the 7/28/04 slide set). Unless otherwise noted, all information about the Unit and the proposed retooling technology comes from those two sources.

installation of its own patented over fire air nozzles. The claimed end results for the retooled Unit include maximized combustion of the fuel, concomitant reduction of criteria pollutants and ash, lower maintenance and operation costs, higher equipment availability and reliability, and higher net power generation.

Currently, 80-90% of the combustion air is under grate air (UGA), while 10-20% is over fire air (OFA). By use of modern computational fluid dynamics modeling to simulate and optimize fuel/air-mixing calculations, unavailable when the original equipment was installed, Jansen would determine a revised configuration of air injection to achieve the results listed above. The expected configuration would include the following elements:

- Removal of the existing OFA system.
- Installation of Jansen nozzles at the elevation of the existing dual arches above the grate.
- Reduction of the UGA to 40-60%.

The reduction of UGA is intended to "ensure sub-stoichiometric conditions and high combustion temperatures which are not diluted with too much (cooling);" those, in turn, would maximize volatilization of the fuel. Burning of the combustible gases rising from the fuel would occur in the OFA zone. The larger diameter of the Jansen nozzles, located six to eight feet above the grate, would provide 40-60% OFA and, as described in the 8/19/04 Request,

allow the high jet penetration and fuel - air molecules shearing action that is necessary to create a highly efficient turbulent mixing action which is not present on the existing Hemphill design. This action is further enhanced by the "venturi" expansion effect after the throat of the existing wall arches. The higher amounts of volatiles that are released from the first stage of combustion interact with this second stage mixing to complete combustion in the hottest region of the furnace to ensure particulate/carbon burnout. The heat released in this second stage also radiates downward to the grate to further improve moisture drying—thus completing the interaction of the two stages with the proper proportioning of the OFA and UGA.

A comparable installation in 2001 at a plant in Campti, Louisiana, of an OFA system with Jansen High Energy Combustion Air Nozzles™, which was intended to "enhance [the] gasification characteristics of the boiler by staging combustion,"³ qualifies as a biomass gasifier under IRS Section 29 tax credit regulations, according to the 7/28/04 slide set.⁴

3. Discussion of the Proposed Biomass Retooling Technology

The RPS regulations at 14.05(1)(a)6 provide that the qualification of biomass generation units is limited to "low emission, advanced biomass power conversion technologies using an Eligible Biomass Fuel." These criteria are designed to insure that the RPS provides incentives for older, dirtier technologies to be replaced by cleaner and more efficient technologies. DOER also believes that biomass technologies should improve over time in response to the incentives created by the RPS, in addition to other regulatory and market forces responsible for continued technological progress in the electricity generation sector generally.

³ Project Description DPB 04, "No. 2 Hog Fuel Boiler Overfire Air System, Willamette Industries, Inc., Campti, Louisiana." Accessed on 12/21/04 at http://www.jansenboiler.com/jansen_descriptions.html.

⁴ See footnote 2.

DOER has determined that the technology proposed for Hemphill does meet the “advanced technology” criterion of the RPS regulations, based on the reasoning set forth below.

The Jansen technology, which would separate the combustion chamber into volatilization and gas combustion zones by means of retooling the combustion air system, shares some characteristics with that of the Wellons close-coupled gasification for which Ware Cogen has already been granted a Statement of Qualification,⁵ although the latter has a higher OFA/UGA ratio and a greater distance between the volatilization and combustion zones. Both represent clear advances over conventional stoker combustion. Both share advantages over fluidized bed technologies with regard to system efficiency, being less complicated and requiring less parasitic load (mainly from reduced need for fan horsepower), with the result that they produce more electricity per quantity of fuel heat input. As a technology for retooling previously RPS-ineligible biomass power plants, the Jansen over fire air technology appears to have as advantages over both the Wellons technology and fluidized bed technologies a lower cost and less complicated installation, reduced generator downtime entailed by the installation, and possibly more optimal air/fuel mixture and combustion.

3. Discussion of the Project’s Biomass Fuels and Air Emissions

DOER notes that the 8/19/04 Request was limited to the proposed retooling technology only, with the intention of later submitting a request for another advisory ruling. However, DOER thought it useful to comment briefly on the other issues that would be addressed in such a subsequent Advisory Ruling, namely the qualification of the Unit's fuel and its air emissions.

The Unit burns whole tree chips and wood residues, supplemented by chipped wooden pallets, which clearly fall within the definition of Eligible Biomass Fuel in the RPS regulations at 14.02.

The Hemphill plant, as it *currently* operates, would not qualify for the RPS “low emission” criterion for a generation unit using an eligible biomass fuel and advanced technology, per the regulations at 14.05(1)(a)6. Neither the limits of its current NH Title V Operating Permit nor its current actual emissions rates are “consistent with emission rates for comparable biomass units as prescribed by the Massachusetts Department of Environmental Protection,” as required in that paragraph of the RPS regulations. However, DOER expects that, subsequent to this present Advisory Ruling, Hemphill will proceed with analysis and design by Jansen, from which they will project air emission rates resulting from the retooling, including any consequently needed changes in pollution control equipment.

4. Conclusion

DOER has found that the technology proposed for the retooling of Hemphill Power and Light qualifies under the regulations for RPS as “advanced.”

Hemphill has stated its intention to submit a request for another Advisory Ruling subsequent to this positive finding on its proposed technology. DOER advises Hemphill, before such a submission, to continue its discussions with both the MA DEP and the New Hampshire Department of Environment Services, in order to include in its request emission rates that the DEP and DOER can find to meet the RPS “low emission” criterion.

⁵ Ware Cogen’s Statement of Qualification is dated 6/21/04. See <http://www.mass.gov/doer/rps/approved.htm> for a list of all qualified Units.